Conceptual Ideas on Radio-geochemical Monitoring for Deep Borehole Disposal of HLRW

GUIDO BRACKE[1], THORSTEN SCHÄFER[2]

[1] GRS gGmbH, Schwertnergasse 1, D-50667 Cologne, Germany, guido.bracke@grs.de

[2] Friedrich-Schiller-Universität Jena, Burgweg 11, D-07749 Jena, thorsten.schaefer@uni-jena.de

As disposal of high level radioactive waste (HLRW) in deep boreholes is a discussed possible option, monitoring technologies for safe operation and disposal are needed [1]. A borefluid will be used for operation and disposal. Given that standard parameters to ensure operational safety are monitored anyway, further monitoring parameters will be needed when disposing HLRW to detect leakages of containers in case of incidents or accidents. Gaseous and dissolved radionuclides and isotopes leaking into the borehole fluid can be used for detection. The isotopic composition of the noble gases He and Xe generated by the HLRW is different from the natural background. The instant release fraction (IRF) from gaps and fuel grain boundaries will contaminate the borehole fluid in case of leakages. The concentration of radionuclides such as Cs-135, I-129, C-14, Se-79, Tc-99 and Sn-126 could be used to monitor the borehole fluid in case of leakage. Any contamination of the borehole fluid with fissiogenic isotopes may be detected by measuring these isotopes in ultra-trace concentrations using highly advanced techniques in mass spectrometry, such as AMS [2]. Although AMS may be adequate to achieve lowest detection limits possible therefore providing maximum time frames for emergency plans the method is currently not suited as on-site or even in-line method. Future developments would be necessary similar to the improvements made for transportable real-time MS in atmossperic aerosol science [3].

[1] Kienzler, Schäfer, Bracke: Conceptual ideas about the radio-geochemical monitoring in deep borehole disposal. In: Bracke et al. (Eds.): Workshop Proceedings “Final Disposal in Deep Boreholes Using Multiple Geological Barriers: Digging Deeper for safety”, GRS-405, 231–250, 2016.

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[3] Pratt & Prather: Mass spectrometry of atmospheric aerosols: Recent developments and applications. Part II: On-line mass spectrometry techniques. Mass Spectrometry Reviews 2012, 31(1), 17-48.